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# A REVISION OF THE KEYHOLE URCHINS (MELLITA)

By Hubert Lyman Clark

Several months ago my good friend Austin Hobart Clark, of the United States National Museum, called my attention to a series of Mellitas in the national collection that offered some problems in identification. He kindly asked me to make a critical study of the material and subsequently sent it to Cambridge. For this favor I am sincerely grateful and offer Mr. Clark my hearty thanks.

Supplementing this most interesting lot with the large series of specimens in the Museum of Comparative Zoology has enabled me to segregate some new forms and to reach some conclusions as to the composition of the genus that are apparently nearer the truth than those hitherto generally held.

In 1921 Lambert and Thiéry in their "Essai de Nomenclature Raisonnée des Echinides" (fasc. 5, p. 324) revived the name *Leodia* (Gray, 1851) for the species of *Mellita* having six lunules. In view of the facts that a fifth lunule is present in ambulacrum III and that the ambulacral lunules do not originate as in *Mellita quinquiesperforata* by the closing up of marginal notches but by resorption of the test through orally developing pits, this action is amply justified.

*Leodia* is apparently monotypic so far as Recent species are concerned, with *sexiesperforata* Leske of the West Indian region as the only valid species. There is an upper Miocene species, *caroliniana* (Ravenel), that is apparently distinct from *sexiesperforata*, but the Recent species *erythrea* Gray and *pacifica* Verrill are of dubious validity. Gray's species is based on specimens of *sexiesperforata*

said to be from the Red Sea—which is too improbable for belief. Verrill's species has never been rediscovered and probably rests on a young *Encope*. It is odd that Lambert and Thiéry, after reviving the genus *Leodia* for species with six lunules, put *caroliniana*, *erythrea*, and *pacifica* in *Mellita*, which they distinctly say is characterized by "cinq lunules."

The genus *Mellita*, restricted thus to those forms having five lunules, four ambulacral and one interambulacral, contains but few species, of which the type, *quinquiesperforata* (Leske), also well known as *pentapora* (Gmelin) and *testudinata* Klein (or, more correctly, Agassiz), is much the best known. Lambert and Thiéry list five others, but as already pointed out three of these are really Leodias. Of the other two, *ampla* Holmes, a fossil species from South Carolina, is undoubtedly a synonym of *quinquiesperforata*, but *longifissa* appears to be a valid species confined to the western coast of Central America and Mexico.

Hitherto the name *quinquiesperforata* has been used for all the 5-lunuled Mellitas found on the eastern coasts of America from Nantucket to southern Brazil, but the material from the National Museum shows that several quite distinct forms have been included under that long name. After critical study of this material, and of the large series in the Museum of Comparative Zoology, it seems best to recognize two new species and a well-marked variety of *quinquiesperforata*. *Mellita* thus becomes a genus of four species and a variety, which may be distinguished from each other by the following key. It must be constantly borne in mind, however, that the younger the specimen, the less well marked are its characters. Individuals less than 40 mm. in diameter cannot always be positively identified.

### KEY TO THE SPECIES AND VARIETIES IN THE GENUS MELLITA

$a^1$. Test more or less circular or pentagonal, its length (100–150 mm. in large adults) nearly equal to its width, often less, but rarely less than 90 percent thereof; apex more or less central, but rarely definitely in front of abactinal system; anterior half of test not markedly thicker than posterior; periproct usually longer than wide, often markedly so; unpaired lunule not very long, about 20 percent of test length.

$b^1$. Test more or less pentagonal, rather stout, the apex tending toward the anterior; periproct little or moderately elongated ---------- quinquiesperforata

$b^2$. Test nearly or quite circular, light and thin, the apex tending to be posterior; periproct very long and narrow. quinquiesperforata var. tenuis

$a^2$. Test more or less elliptical, the width greatly exceeding the length (70–98 mm. in large adults); length only 80–90 percent of width; apex anterior, usually very evidently so; anterior

half of test much thicker than posterior, the slope from margin to apex being usually quite abrupt; periproct commonly more or less circular (except in *longifissa*); unpaired lunule very long, usually 25–40 percent of test length.

$b^1$. Unpaired lunule of interambulacrum 5 long and narrow, 25 to 40 percent of test length, its breadth less than 10 percent of its length; ambulacral intermediate areas I and V on oral surface long and narrow, greatest width less than 40 percent of length; periproct much longer than wide ..... longifissa

$b^2$. Unpaired lunule usually less than 30 percent of test length, its breadth 15 to 20 percent of its length or more; ambulacral intermediate areas I and V on oral surface with their greatest width more than 40 percent of length; periproct more nearly circular.

$c^1$. Ambulacral intermediate areas on oral surface notably wide, in II and IV the width is more than half the length; heads of the minute, capitate, dorsal primaries of nominal size; length of test 85 to 91 percent of width ..... latiambulacra

$c^2$. Ambulacral intermediate areas on oral surface not unusually wide, in II and IV the width is less than half the length; heads of the minute dorsal primaries much enlarged; length of test 80 to 85 percent of the width ..... lata

The new forms diagnosed in the above key may be described as follows:

## Genus MELLITA Agassiz

### MELLITA LATA,[1] new species

PLATE 60, FIGURE 1; PLATE 61, FIGURE 1; PLATE 62, FIGURES 1, 2

Test rather stout, especially anteriorly, 70 mm. long by 87 mm. wide and 8 mm. high at apex, 20 mm. back of the anterior margin; posterior margin only 2 mm. thick; the slope up from anterior margin to apex is somewhat abrupt. Center of abactinal system back of apex, 32 mm. from anterior margin; genital pores four. Petaloid areas 44 mm. long and about 42 mm. wide; unpaired petal (III) 18 mm. long (from ocular pore to tip) by 10 mm. wide, narrowed at tip but not closed; petals II and IV, 17 by 12 mm., widest distal to middle, narrowly open, the interporiferous areas curved backward a trifle as if to join the anterior lunules; petals I and V, 22 by 12 mm., widest near the narrowly open tip. All petals very blunt. Lunules II and IV about 20 mm. long by 2 mm. wide, distinctly curved with the concavity anterior; lunules I and V a little shorter, wider, and less curved; unpaired lunule 24 mm. long and more than 3 mm. wide, reaching to within 7 mm. of the posterior margin of the test. Periproct about 3 mm. long by 2.5 mm. wide, its anterior margin 3 mm. posterior to the rear margin of the

[1] *Latus* = broad, in reference to the extraordinary width of this species.

peristome, which is nearly as wide as long. Ambulacral plates form five small knobs, which project rather conspicuously over the peristome, more noticeably than in the other species of the genus. Ambulacral furrows of lower surface conspicuous, the intermediate area in each ambulacrum not very broad; in II and IV these areas are about 40 mm. long by 15 mm. wide.

Primary spines of the dorsal surface less than 1 mm. long, very slender, but conspicuously and rather abruptly capitate, the heads being noticeably larger than in the other species. Surrounding the lunules and around the margins of the test the primaries are 2 to 3 mm. long, flattened and blunt, not at all capitate; around the lunules, particularly the unpaired one, they are markedly widened at tip. On the oral surface the spines are 4 mm. long, more or less, very slender, and are nearly horizontal in position; in the anterior interambulacra (2 and 3) they point outward, but in 1 and 4 they point inward, while in 5 they point to the lunule or midline. Prolonged search over both the holotype and the equally well preserved paratype failed to reveal even a single pedicellaria.

Color greenish gray above with the margins of the lunules and of the test appearing more silvery, owing to the translucency of the longer spines; the lower surface is definitely brown, except as modified by the silvery spines

*Locality.*—Near Port Limon, Costa Rica, from "high and dry" on the sand beach; George T. Kenley, collector.

*Holotype.*—U.S.N.M. No. E. 5655.

*Notes.*—Besides the holotype there are two paratypes taken at the same time and place by Mr. Kenley. The larger is 60 mm. long, 72 mm. wide, and 6.5 mm. high. The form of the test and general appearance are exactly as in the holotype, except that the color is distinctly brown on both surfaces. Under a lens the large, flat, broad-tipped spines bordering the unpaired lunule show clearly a fundamental green-gray color (as in the holotype) slightly tinted with brown. As this specimen was taken in about 3 feet of water, it is not unlikely that the normal color of *lata* is brown and the greenish gray of the dorsal surface of the holotype is due to bleaching while "high and dry" on the beach.

The third specimen from Port Limon is a bare and defective test 59 by 71 mm. showing no notable peculiarities.

There are also in the National Museum material two small bare tests, which, in spite of their obvious immaturity, may yet be considered paratypes. The larger is 48 by 58 by 7 mm. and is thus relatively high, while the anterior upward slope of the test is more abrupt than in any other specimen. The smaller is 40 by 44 by 4.5 mm., the length and breadth being more nearly equal than in adults.

These two bare tests are from La Mancha, Veracruz, Mexico, and are the gift of A. L. Herrera.

In the Museum of Comparative Zoology there are three specimens of this species, but unfortunately they have no label to show their origin. They have been in the collection for at least 70 years and are labeled *Mellita quinquiesperforata* and (from early years) *Mellita testudinata.* The largest is nearly bare but retains a band of the conspicuously capitate primary spines around the posterior margin, dorsally. It is 64 by 74 by 6.5 mm. but is curiously deformed in the anterior left quadrant; petal IV is only 14 mm. long, while II is 21 mm., and lunule IV is only 11 mm. long, while II is 14 mm.; there are two genital pores in interambulacrum 2. The second specimen is smaller 60 by 68 by 7 mm., but is a fine, symmetrical, bare test. The smallest is only 38 by 44 by 4 mm. and still retains its covering of spines, but they are matted together by some sort of adhering and long-since dried slime. Although the origin of these specimens is unknown, they are clearly to be referred to *lata* and are hence considered paratypes.

Typical examples of this species are unmistakable, for aside from the excessive width the anterior position of the apex is a striking feature, and the large "heads" of the dorsal primary spines give a texture to the upper surface of well-preserved specimens that is different from the other species of *Mellita.*

As yet *lata* is known only from the eastern coast of Costa Rica and southern Mexico. How far to the north or south it ranges we can only guess, but it apparently does not reach either Texas or Venezuela, as the Mellitas at hand from those coasts are not *lata.* However, it must be admitted that no Mellitas from southern Texas or western Venezuela are as yet known.

### MELLITA LATIAMBULACRA,[2] new species

PLATE 62, FIGURES 3–6

*Description.*—Test moderately thick, 99 mm. long, 106 mm. wide, and 10 mm. high at apex, 40 mm. from the anterior margin, which is 2 mm. thick, the posterior margin being little more than half as much. The slope up from anterior margin is rather gradual. Abactinal system very close to apex, but slightly posterior; genital pores four. Petaloid area large, about 60 mm. long by 55 mm. wide; unpaired petal (from ocular pore to tip) 27 mm. long by 15 mm. wide, narrowed at tip, but not closed; petals II and IV, 28 by 14 mm. a little distal to middle, narrowly open, the interporiferous areas

[2] *Latus* = broad + ambulacra, in reference to the very wide, oral, ambulacral, intermediate areas.

quite straight; petals I and V, 34 by 17 mm., widest at or very near the tip and well open there. All petals blunt, the posterior pair being almost truncate. Lunules II and IV about 18 mm. long by 3 mm. wide, nearly or quite straight although the posterior margin may be concave; lunules I and V similar, a trifle shorter but about the same width; unpaired lunule long and nearly straight, about 30 mm. long by 4.5 mm. wide, reaching to within 13 mm. of the disk margin. Periproct about 4.5 mm. long by 2.5 mm. wide, its anterior margin scarcely 4 mm. from the margin of the peristome, which is about 4 mm. in diameter, rounded-pentagonal, the ambulacral knobs on the margin relatively low and inconspicuous. Ambulacral furrows of lower surface conspicuous, the intermediate areas in each ambulacrum being notably wide; in II and IV these areas are 45 mm. long and 24 mm. across where widest.

Primary spines of dorsal surface less than 1 mm. long, very slender and abruptly capitate; but the heads are relatively small when compared with those of *M. lata;* they are distinctly larger than in *M. quinquiesperforata.* Surrounding the lunules and around the margin of the test the primaries are 2–3 mm. long, flattened and blunt, not at all capitate; around the lunules, particularly the unpaired one, they are widened at the tip but not so conspicuously as in *lata.* On the oral surface the primaries are as in other Mellitas, 3–4 mm. long, very slinder, more or less horizontal in position, and arranged so that in any given area they all point in the same direction. No pedicellariae have been found.

In color the holotype is light brown with a grayish tint abactinally, more reddish brown on the oral surface.

*Locality.*—Cumaná, Venezuela; Captain Couthouy, 1859.

*Holotype.*—M.C.Z. No. 246.

*Notes.*—There are two paratypes from Cumaná, but they are perfectly bare though not at all bleached; the larger is 94 by 109 by 10 mm., with the apex only about 30 mm. from the anterior margin; the oral ambulacral area IV is 43 by 22 mm.; the color is brown, with the aboral side unevenly tinted with violet or greenish. The smaller specimen is 88 by 96 by 10 mm., with the apex about 35 mm. back; oral ambulacral area IV is 41 by 24 mm., and the upper surface has a distinctly greenish cast.

There are additional paratypes in the Museum of Comparative Zoology. One from Manzanilla Beach, east coast of Trinidad, 68 by 78 by 8 mm., has the apex a little more than 20 mm. back and the oral ambulacral areas II and IV, 34 by 20 mm.; the color above is dull greenish, orally brown. From Mayaro Bay, east coast of Trinidad, there are four small nearly bare specimens, one of which is notable for its relatively long, narrow form, 57 by 63 mm.; while the others

are 49–52 by 57–62 mm. From Bahia, Brazil, there are two bare half-grown tests, one of which is in fragments. From Itabapuana, Brazil, there are nine bare tests of young individuals, 37 by 42 mm. up to 59 by 68 mm., the smallest with the apex very high (6 mm.) and far back (16 mm.), and the posterior lunules I and IV are still open at the margin. From off Barbados in 100 fathoms there is a very young individual collected by *The Hassler*, 12 by 13 mm. with the paired lunules indicated only by slight notches in the test margin while the oral ambulacral areas II and IV are little more than 4 mm. long, and their distal width is nearly 3 mm.

In the lot of Mellitas from the United States National Museum there are seven specimens to be referred to this species, and though all are young they are quite typical and are to be considered paratypes. The largest is a bare and water-worn test 57 mm. long by 65 mm. wide, with the apex 6 mm. high and 23 mm. back of the margin. It is said to be from the coast of the State of São Paulo, Brazil. From Itajahy, Brazil, are five young specimens, three of which are notable for having retained most of their spines; the general color is a light greenish gray, but the oral ambulacral areas are more or less violet-brown in rather noticeable contrast; areas II and IV are conspicuously wide, 22 by 13 mm. in the largest specimen, which is 48 by 55 by 4.5 mm.; the smallest is only 42 by 45 mm. The bare tests are also small individuals, and the larger is notable for its pale blue-green color. From the beach at Santos, Brazil, is a young bare test 43 by 40 mm., with the oral ambulacral areas II and IV scarcely 20 mm. long though fully 11 mm. wide.

Even extreme examples of this species do not equal the wide proportions of *lata*, but they do exceed the widest *quinquiesperforata* available for comparison. In this particular it is probable that no hard and fast specific lines can be drawn, but in the great width of the oral ambulacral intermediate areas, especially in II and IV, a very trustworthy specific character is found. Of course, in young individuals (less than 40 mm. long) it is not so marked as in adults. The great thickness of the anterior half of the test as compared with the posterior is also a useful character, and in mature specimens the great length of the unpaired lunule is a notable feature.

This seems to be the characteristic *Mellita* of Trinidad and the eastern Venezuelan coast. How far the range extends to the west is still to be determined, but southward it seems to include practically the whole coast of Brazil, even to the State of Santa Catherina. The puzzling thing about this vast range is that *quinquiesperforata* also seems to occur on the Brazilian coast; at least there are bare tests in the Museum of Comparative Zoology taken by the Thayer expedition at Maranhão that are undoubtedly the

common northern species. But as similar tests are in the Museum of Comparative Zoology from "off Nantucket," whereas the species is not known to *live* farther north than Chesapeake Bay, it may be these bare tests from Maranhão need not be construed as evidence that *quinquiesperforata* really occurs living on the Brazilian coast. Obviously the actual ecological relationships of *latiambulacra* and *quinquiesperforata* are completely obscure.

### MELLITA QUINQUIESPERFORATA TENUIS,[3] new variety

PLATE 60, FIGURE 2; PLATE 61, FIGURE 2

*Description.*—Test notably light and thin, very nearly circular but somewhat narrower anteriorly and with slight reentering curves at each end. The diameter along different axes ranges from 103 mm. through III–5 to 109 mm. through I–3, but the usual measurement is about 107 mm. Apex posterior to abactinal system, at or a little posterior to center of test; at that point the test is almost 10 mm. high. The slope from margin to apex is quite uniform and gradual from all sides; the margin in III is barely 2 mm. thick and in 5 it is just 1 mm. Genital pores 4. Petaloid area of moderate size, about 58 mm. long by 55 mm. wide; unpaired petal (ocular pore to tip) 25 mm. long by 14 mm. wide, narrowed at tip and but little open there; petals II and IV 24 by 12 mm., narrowly open, the interporiferous areas quite straight; petals I and V 30 by 15 mm., narrowed at tip and scarcely open there. Lunules strikingly small and straight; II and IV 10 mm. long by 2.5 mm. wide, I and V 11 by 2.5 mm., and the unpaired lunule 18 by 3.5 mm., its posterior end 20 mm. from the test margin. Periproct very long and narrow, 4.5 by 1.25 mm., its anterior margin only 3.5 mm. from the posterior margin of the peristome, which is small, rounded-pentagonal, only 3 mm. in diameter; the ambulacral knobs are small and inconspicuous. Ambulacral furrows of oral surface well marked, but the intermediate areas are rather narrow; in II and IV these areas are 47 mm. long but only 21 mm. in maximum width.

Primary spines of dorsal surface less than 1 mm. long, very slender at base but swollen at the tip into a conspicuous ovoid head about one-third the length of the entire spine. Surrounding the lunules and around the margin of the test the primaries are elongated, narrow, flattened, and blunt, but they are not widened at the tip, rather they may be narrowed. On the oral surface the primaries are slender and elongated and arranged so that they lie almost horizontally and pointing in definite directions, as in the other species of *Mellita*. No pedicellariae have been detected.

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[3] *Tenuis*=thin, in reference to the texture of the test as compared with that of the species itself.

The color is uniformly brown; orally the test is a brighter, more yellowish, brown than on the upper surface.

*Locality.*—Northwest of lighthouse 2 miles outside of Sanibel Island, Fla., from a sandbar in 3–4 feet of water; W. J. Clench, February 1929.

*Holotype.*—U.S.N.M. No. E.5656.

*Notes.*—There are in the United States National Museum two paratypes of this variety. The larger is from Tarpon Springs, Fla., where it was collected by Edwin J. Shadle. It is 98 by 102 mm. in diameter and is a lighter and yellower brown than the holotype. The other specimen, collected by Dr. W. H. Dall at Charlotte Harbor, Fla., is almost circular, 55 m. in diameter, and has the apex unusually far back, just in front of the unpaired lunule. The color is like the Tarpon Springs material. In the Museum of Comparative Zoology collection are a number of specimens of this variety from Sanibel Island, Fla., of which half a dozen are paratypes collected with the holotype by Mr. Clench in February 1929. The smallest is only 44 mm. long and almost 44 mm. wide; the test is very thin and delicate, scarcely 3 mm. thick at the apex, which is very close to the center of the test; the color is a deep gray above, light brown beneath, with many light greenish-blue lines and areas, specially near the mouth. The larger specimens are like the holotype in color and range from 74 to 104 mm. in length, with the width the same or a millimeter more or less, except one that is 99 mm. long by 104 mm. wide. In all these specimens the apex of the test is at or behind the center, and the lunules are uniformly small. Besides these specimens the Museum of Comparative Zoology contains, also from Sanibel Island, a bare but not bleached test 120 by 125 mm., a water-worn test 78 by 81 mm., and a very young specimen only 19 mm. in diameter in which the paired lunules are not yet closed in. There are also five small specimens from an unknown locality of which the largest is 71 by 68 mm., with the apex very evidently at the anterior end of the unpaired lunule, while the other specimens, 48–57 mm. long (with width about the same), are rounded pentagonal, more or less asymmetrical, and have the anterior margin notably straight rather than curved. There are also 10 very young Mellitas, 23–36 mm. in diameter, dredged half a mile off the eastern end of Sanibel Island in 1–2.5 fathoms by W. J. Clench on April 6, 1933, which are naturally to be considered the young of *tenuis*, although of course in such immature specimens the varietal characters are not conspicuous. But the posterior position of the apex is a fairly distinctive feature. The Museum of Comparative Zoology has also a paratype from Tarpon Springs, Fla., taken by Edwin J. Shadle, 89–93 mm. in diameter, received from the United

States National Museum. Finally, it seems best to refer to this variety three large specimens that Alexander Agassiz collected many years ago at Captiva Key, Fla., near Sanibel Island. These specimens range from 100 by 110 mm. to 129 by 129 mm. and are notably thicker and solider than typical *tenuis*, and the apex is evidently central or anterior. Such specimens prove that *tenuis* is not a well-defined species yet. But typical examples of this *Mellita* are so conspicuously different from ordinary *quinquiesperforata* that when the Tarpon Springs and Charlotte Harbor specimens were first examined it seemed quite clear that they represented a well-marked species characteristic of the west coast of Florida. The large series available of the common species shows, however, that there are numerous connecting links, and the conclusion was reluctantly reached that *tenuis* must be rated as a variety merely. There are specimens at hand from the Carolina coast that are so similar to those from Sanibel Island that they cannot be distinguished by constant measurable characters. On the other hand, there are the three large specimens from Captiva Key, mentioned above, which are too much like ordinary *quinquiesperforata* to justify specific separation. An interesting point in the matter is that specimens from the coast of Texas and western Louisiana are normal *quinquiesperforata*.

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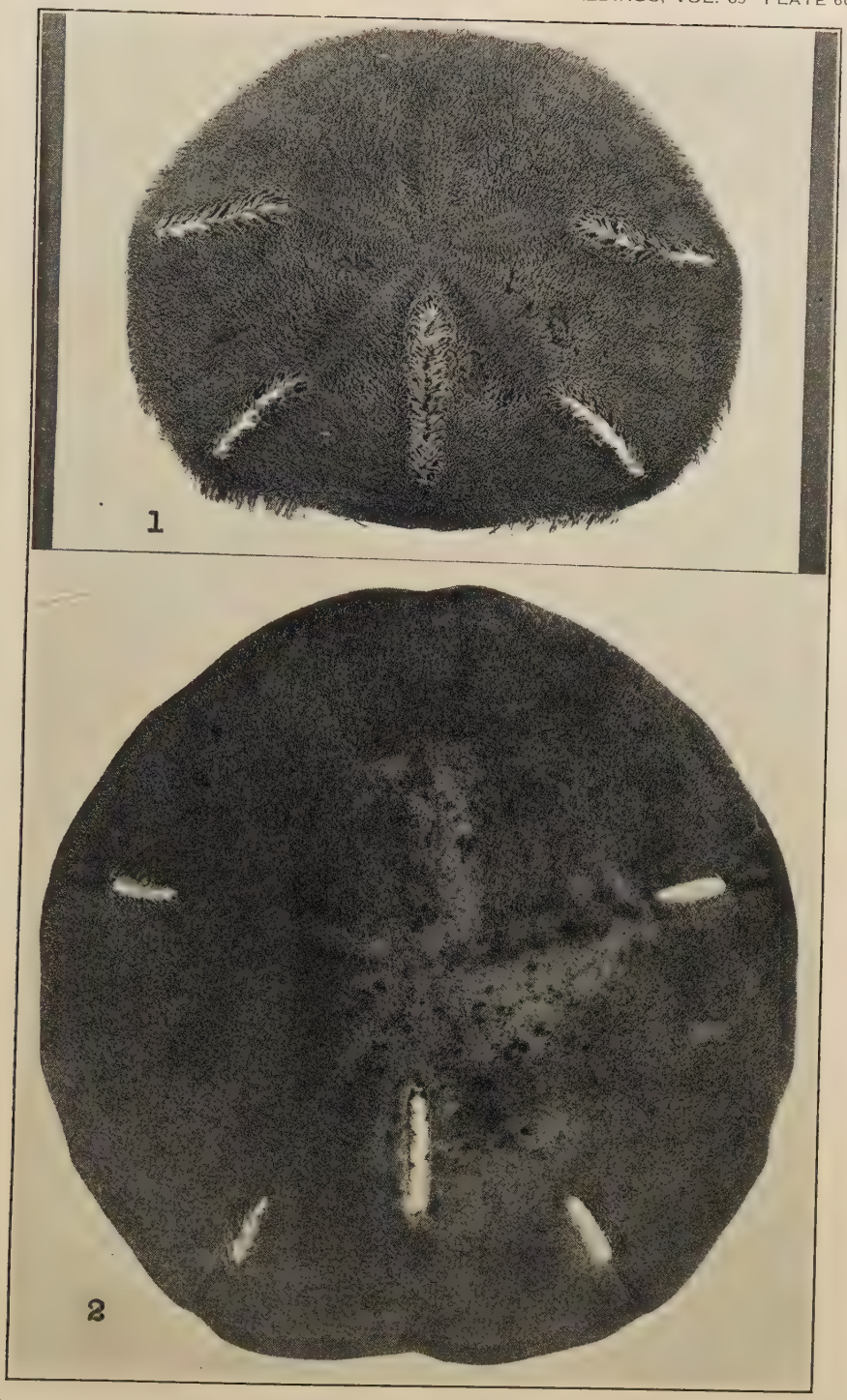
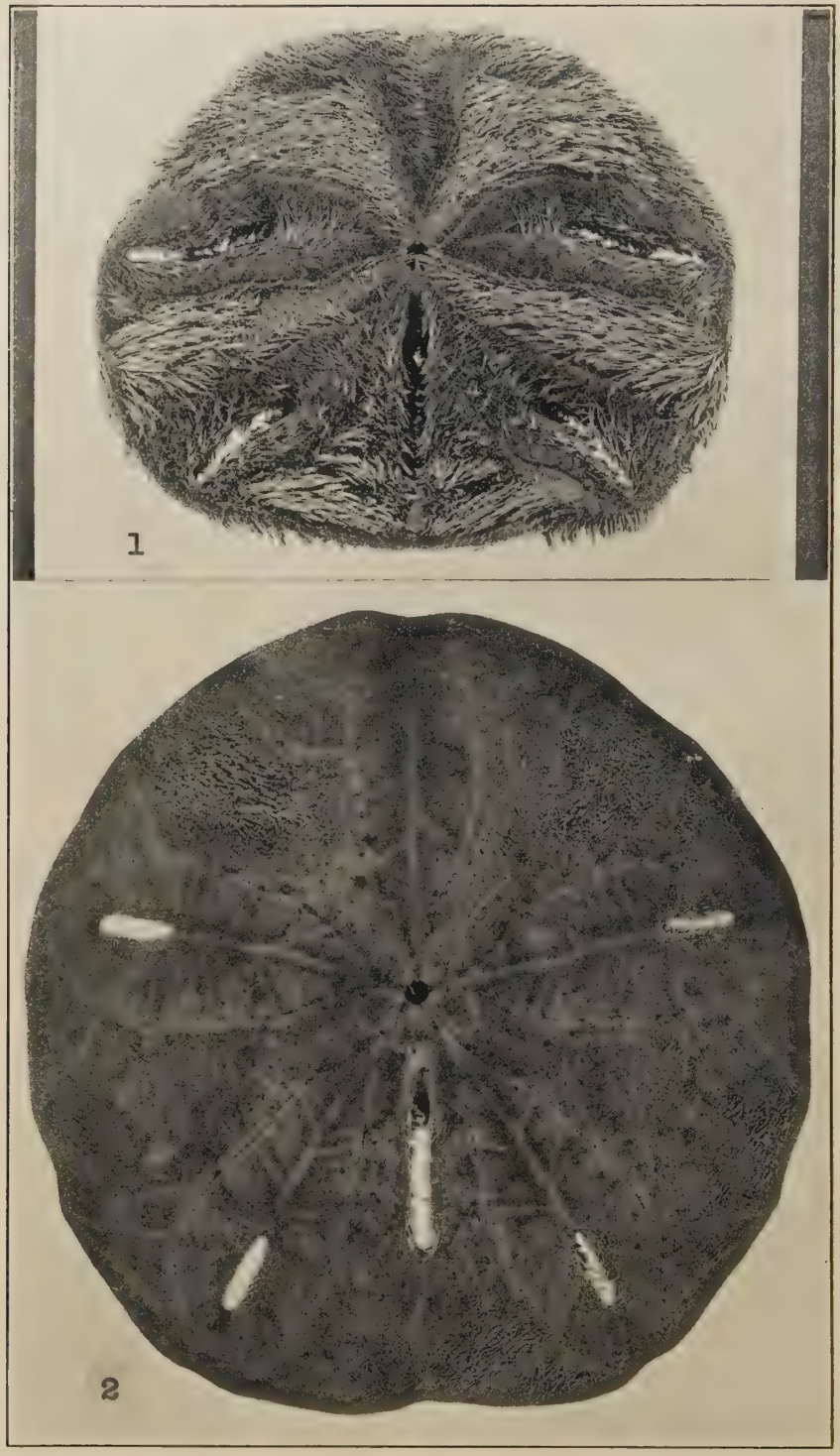
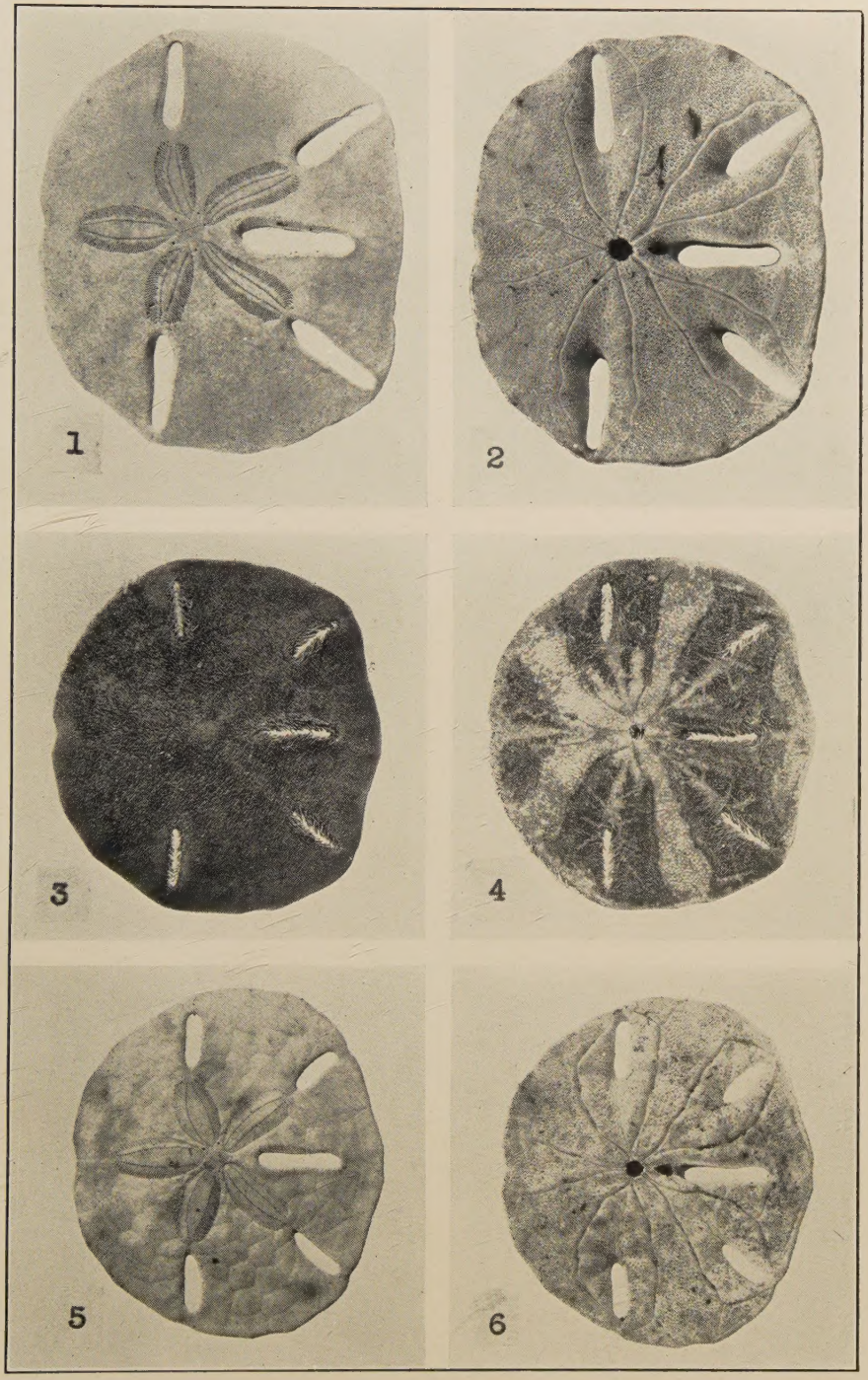



1, *Mellita lata*, new species: Type. Aboral surface. From Port Limon, Costa Rica.
2, *Mellita quinquiesperforata tenuis*, new variety: Type. Aboral surface. From Sanibel Island, Fla.




1, *Mellita lata*, new species: Oral surface of specimen shown in pl. 60, fig. 1.

2, *Mellita quinquiesperforata tenuis*, new variety: Oral surface of specimen shown in pl. 60, fig. 2.




1, 2, *Mellita lata*, new species: Bare test, aboral and oral surfaces, of small specimen from La Mancha, Veracruz, Mexico.

3–6, *Mellita latiambulacra*, new species: Young; 3 and 4 with spines; 5 and 6, bare test. From Santos, Brazil.